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December 16, 2013

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Mr. Steve Faryan
On-Scene Coordinator
U.S. Environmental Protection Agency Region 5 (SC-5J)
77 W. Jackson Blvd.
Chicago, IL 60604

RE: Field Sampling Plan
Former Standard Oil Bulk Plant #5482
Wedron, LaSalle County, Illinois

Dear Mr. Faryan,

BP Products North America Inc. (BP) is submitting a Field Sampling Plan (FSP) for the Former Standard Oil Bulk Plant #5482 (Site). The FSP provides a summary of the recently completed geophysical survey, utility locations and historical document research, which was used to guide the proposed soil sampling locations. Soil sampling activities are intended to evaluate subsurface conditions resulting from historical operations conducted at the Site. The FSP has been prepared in support of an Administrative Order on Consent (AOC) as entered into voluntarily by the United States Environmental Protection Agency (EPA) and BP. The AOC provides for the preparation and performance of monitoring, testing, analysis and reporting on property formerly leased by BP's corporate predecessor at the Wedron Ground Water Contamination Site located in Wedron, LaSalle County, Illinois (the Wedron Site). Site background and investigation activities are summarized below.

Background

The Site is located on a railroad right-of-way on the east side of Wedron, Illinois along Route 11 (Figure 1). BP's corporate predecessor, Standard Oil Company (Indiana) leased the property from the railroad from approximately 1921 to December 1971. The property was used for petroleum bulk plant operations. Site plans attached to leases dating from 1926 to 1942, indicate the presence of a warehouse and two storage tanks. Additionally, Standard Oil leased a limited area between the property and railroad to accommodate above ground two inch diameter unloading pipes and an unloading rig. Historical correspondence indicates that by December 1971, the warehouse (garage), oil storage tanks, unloading pipes and storage barrels were removed from the property.

Previous investigations adjacent or near the subject property include the removal of a 560-gallon underground storage tank (UST) in July 2012 by Illinois Railway, LLC. The UST was uncovered on July 18, 2012 during construction of new siding track (near the eastern edge of the Site). During the removal of the UST, approximately 80 tons of impacted soils were removed and disposed of. A total of twelve soil samples were collected from the floor and sidewalls of the excavated areas. The samples were submitted for laboratory analysis of benzene, toluene, ethylbenzene, and total xylenes (BTEX), and total lead analyses. During the UST removal, a representative of Illinois Railway contacted the Illinois Emergency Management Agency (IEMA) and incident number 20120767 was assigned to the release. A 45-Day Report/Corrective Action Completion Report which

provided a summary of the removal activities and data collection was submitted to the Illinois Environmental Protection Agency (IEPA) on August 7, 2012. The report requested a No Further Remediation (NFR) letter for the incident. The IEPA approved the request and granted Illinois Railway a NFR for the release on August 20, 2012. Ownership of the UST is unknown.

On August 23, 2012, six soil borings were advanced in the area of the former UST as part of a voluntary site assessment by Illinois Railway. Samples were collected and submitted for analysis of BTEX and total lead. No analyzed parameters were identified in exceedance of TACO Tier 1 industrial/commercial soil remediation objectives. The data was summarized in a report prepared on behalf of Illinois Railway, titled Voluntary Environmental Site Assessment, Illinois Railway Easements, dated October 2012.

On May 16, 2013, one groundwater monitoring well (MW-5) was installed by GZA for Wedron Silica near the former bulk plant as part of a larger investigation completed in association with the EPA's Wedron Groundwater Site investigation. One soil sample was collected during installation of the monitoring well and analyzed for volatile organic compounds (VOCs). Benzene was detected at concentrations greater than TACO standards for the soil component of the groundwater ingestion exposure route for Class I groundwater. Based on information obtained from the MW-5 boring log, groundwater was not encountered above bedrock, as a result and a 15 foot well screen was set into the upper portion of the sandstone. Available data indicate no VOCs were present in groundwater at concentrations above method detection limits at the samples collected from MW-5 on May 30, 2013.

In addition to site activities that are referenced above, Stantec has completed the following activities per the requirements of the AOC:

- Geophysical survey of accessible portions of the property,
- Property boundary survey
- Public utility location using the Illinois Joint Utility Locating Information for Excavators (JULIE) utility locating service
- Historical document research
- Health and Safety Plan
- Quality Assurance Project Plan

Geophysical Survey

A geophysical survey of the Site was completed by Ground Penetrating Radar Systems, Inc. (GPRS) on October 30, 2013. The geophysical survey was completed on the property and a portion of the adjacent right-of-way associated with former piping and unloading rig using ground penetrating radar (GPR) and electromagnetic interference (EMI) equipment. The geophysical survey was used to indicate the potential presence of a metallic objects such as piping, underground storage tanks, buried drums, or to identify potential unknown or abandoned buried utilities.

The Proposed Work Plan (BP, September 19, 2013) provided a description of the proposed geophysical survey locations; however, the steep slope conditions at the Site resulted in modifications to these locations that limited GPR to only flat portions of the Site and adjacent right-of-way. Figure 2 provides the approximate locations of the GPR survey; an EMI survey occurred over the entire surface of the Site and adjacent right-of-way.

The results of the geophysical survey were provided to EPA on November 15, 2013. GPR scanning of the flat portions of the Site and adjacent right-of-way did not reveal subsurface anomalies that were consistent with buried metallic objects such as underground storage tanks. The EMI scanning, which was conducted across the entire Site and adjacent right-of-way, including the steep slope, revealed anomalous readings directly adjacent to the railroad tracks where rail cars were located and at a location along the right shoulder of Route 11 believed to be a groundwater monitoring well (MW-5). The EMI survey did not identify any subsurface

anomalies that were consistent with buried metallic objects such as underground storage tanks or piping.

Property Boundary Survey

The property boundaries of the land originally leased by the Standard Oil Company, as described on the survey drawing completed on October 2, 1935, were staked by Atwell on October 29, 2013. The original property boundary was based off of Mile Post #73 and the centerline of the main track. Atwell located the main track and objects in the area that had recorded mile post stationing data. Atwell also used the railroad Valuation Map for the area to locate existing physical objects in the area referenced on the Valuation Map to establish the mile post stationing, since Mile Post #73 was previously destroyed. Once Atwell had located the track centerline, established the railroad mile stationing, the limits of the described land were staked in the field. On October 30, 2013, GPRS used Global Positioning Systems (GPS) technology to provide GPS coordinates of the property corners.

Utility Locations

Public utilities were notified using the Illinois Joint Utility Locating Information for Excavators (JULIE) utility locating services and was completed on October 29, 2013. Additionally, utilities were surveyed during the geophysical survey. JULIE did not identify any subsurface utilities during locating activities. There was, however, one erroneous sewer line mark that originated at MW-5, which is located along the east shoulder of Route 11. The geophysical survey did not identify subsurface anomalies that were indicative of utilities.

Historical Document Search

The following historical documents were used to identify Site features and historical bulk plant infrastructure: 1) Standard Oil Company leased land survey from 1935; 2) Sanborn Fire insurance maps from 1901-1951; 3) aerial photos from 1939 and 1951; and 4) correspondence between Standard Oil Company and Burlington Northern from October 1970 and January 1972. Bulk plant infrastructure believed to have been present prior to the closing of Site includes:

1. Garage/warehouse
2. Vertical above ground storage tanks (ASTs)
3. Product unloading rig
4. 2" galvanized pipes from unloading rig to ASTs

Internal Standard Oil Company correspondence and correspondence between Standard Oil Company and Burlington Northern, indicate that Standard Oil Bulk Plant #5482 permanently closed on October 16, 1970; product was removed from tanks on or before February 25, 1971; garage/warehouse and tanks were removed on or before August 9, 1971; and the unloading rig was removed on or before December 23, 1971. On January 28, 1972, Burlington Northern provided written notice to Standard Oil Company that Plant #5482 had been cleared, enabling termination of the lease agreement.

Based on the results of the geophysical surveys, utility locate, historical document search, and excavation activities during construction of new siding track at the eastern boundary of the Site, there does not appear to be any subsurface features that warrant further investigation via test pits or other intrusive or non-intrusive methods.

Soil sampling will proceed as was described in the Proposed Work Plan (BP September 19, 2013) with location modifications as a result of the inability to drill on the steep slope portion of the Site.

The soil sampling activities will be completed in accordance with all applicable subsections of IEPA, Title 35: Environmental Protection, Subtitle G: Waste Disposal and Chapter I: Pollution Control Board, Subchapter D: Underground Injection Control and Underground Storage Tank

Programs. Laboratory procedures and methods will meet the minimum specified detection limits in accordance with TACO: 35 IAC Part 742 and Part 734 of Subchapter D, Petroleum Underground Storage Tanks, specifically Section 734.415 regarding Data Quality.

Field Sampling Activities

Soil Boring Installation

Soil borings will be limited to the flat western (upper) Site boundary and eastern (lower) Site boundary where accessibility is not limited by steep terrain. Nine soil borings will be installed using direct push technology and will be advanced from ground surface to refusal/bedrock, or the groundwater table. Soil borings will be distributed at a higher density on the southern half of the Site where structures/tanks were historically located and at a lower density on the northern half of the Site. Five soil borings will be completed along the western Site boundary, consisting of three soil borings on the southern half and two soil borings on the northern half. Four soil borings are proposed along the eastern boundary of the Site. All soil boring locations will be recorded using GPS following completion of field activities.

Site utility locating was performed by JULIE and GPRS in October 2013 and no subsurface utilities were identified.

Due to potential scheduling delays associated with access limitation, potential railroad setback requirements and BP health and safety procedures, the soil borings installed along the eastern Site boundary may not be completed during the same Site mobilization as the western Site boundary soil borings. Proposed soil boring locations are included on Figure 2.

Based upon the findings from the soil investigation, installation of permanent monitoring well(s) is proposed if soil concentrations are above TACO Tier 1, Class I soil component of groundwater ingestion remediation objectives. The borings will be utilized to characterize the fill and subsurface materials and help delineate the presence or absence of gasoline-related constituents on the property.

A minimum of two soil samples from each soil boring location will be collected for analysis. The samples will be screened with a sensitive photoionization detector (PID), such as the UltraRae 3000 or equivalent. The samples will be collected based on PID readings and field observations with the goal of achieving vertical delineation of impacted soils above the water table. If there are no elevated PID readings, then one sample will be collected from 0-3 feet below ground surface (bgs) in undisturbed soil and the other from the bottom of the boring just above the water table or at the top of the bedrock. If there are elevated PID readings at only a single depth, then one sample will be collected at that depth and the other from the bottom of the boring just above the water table, or at the top of the bedrock. No soil samples will be collected below the water table. Each soil boring will be logged in accordance with USCS and recorded on a boring log. Each log will begin with a description of the surface and every foot of the soil boring will be accounted for, with no gaps. PID readings will be collected at a minimum of every two feet and at changes in lithology and will be recorded on the boring log. Soil sampling and soil logging procedures are detailed in Stantec's Soil Sampling SOP included as Attachment 1.

Soil Sampling

Soil samples will be analyzed for VOCs via Method 8260B, semi-volatile organic compounds (SVOCs) via Method 8270C, total lead via Method 6010, and gasoline- and diesel-range organics (GRO/DRO) total petroleum hydrocarbons (TPH) via Methods 5031/8015 and 8015, respectively. The soil samples selected for analytical testing will be placed in the appropriate containers provided by the laboratory, logged, labeled, placed in iced coolers, and sent to

Pace Analytical Services, Inc. (Pace), of Minneapolis, Minnesota for analytical testing using standard chain-of-custody procedures.

Quality control samples will be collected in the field, including field duplicates, trip blanks, and MS/MSDs. The soil samples selected for analytical testing will be placed in the appropriate containers provided by the laboratory, logged, labeled, placed in iced coolers, and sent to Pace, of Minneapolis, Minnesota for analytical testing using standard chain-of-custody procedures. Sample collection and sample analysis procedures will be in compliance with the approved Site Investigation Quality Assurance Project Plan (QAPP).

Groundwater Monitoring Well Installation

If soil results indicate the presence of impacted soils above TACO Tier 1, Class I soil component of groundwater ingestion remediation objectives, a minimum of three monitoring wells will be installed at the locations of the elevated concentrations. If several boring locations indicate soil concentrations above TACO Tier 1, Class I soil component of groundwater ingestion remediation objectives, the areas with more elevated concentrations will be targeted for monitoring well installation. Proposed locations for monitoring wells will be provided to the EPA beforehand to allow for review and approval.

The monitoring well(s) will be drilled with a truck-mounted drill rig or suitable alternative, capable of drilling into bedrock. The monitoring well(s) will be constructed with ten feet of two-inch diameter Polyvinyl Chloride (PVC) flush-threaded screen (0.010-inch slot) attached to solid PVC casing. The bottom of the screened interval will be capped with a threaded PVC bottom cap, and the top of the solid casing will be closed with a two-inch diameter lockable expansion plug-type cap. The monitoring well(s) will be constructed such that the screened interval will intersect the water table during seasonal groundwater fluctuations. A flush mounted well box with a bolt down cover will be installed into concrete to surround and protect the top of the well.

After well installation, the monitoring well(s) will be developed to allow free entry of water, to minimize turbidity of the sample, and to minimize clogging.

Monitoring wells will be located in the field using hand-held GPS and surveyed to measure the top of casing and groundwater elevations. BP will work with the EPA to tie in site specific survey data to survey data collected in association with the Wedron Ground Water Contamination Site.

Groundwater Monitoring Well(s) Sampling and Water Level Measurements

Prior to collecting a groundwater sample, static water levels will be measured and recorded using an electronic oil/water interface probe capable of detecting the presence of water and any liquid-phase hydrocarbons (LPH). Groundwater samples will be collected from the monitoring well(s) using low-flow methodologies. Low flow monitoring well purging and sampling procedures are detailed in Stantec's Low Flow Groundwater Sampling SOP included as Attachment 2. The samples will be analyzed for VOCs via Method 8260B, SVOCs via Method 8270C, and GRO/DRO TPH via Methods 5031/8015 and 8015, respectively.

Quality control samples will be collected in the field, including field duplicates, trip blanks, and MS/MSDs. The groundwater samples selected for analytical testing will be placed in the appropriate containers provided by the laboratory, logged, labeled, placed in iced coolers, and sent to Pace, of Minneapolis, Minnesota for analytical testing using standard chain-of-custody procedures. Sample collection and sample analysis procedures will be in compliance with the approved Site Investigation QAPP.

Additional sampling of the monitoring wells will be based upon the sample results and direction from the EPA. The wells will remain in place until regulatory approval for abandonment is provided.

Decontamination and Investigation-Derived Waste

Tools and equipment will be steam cleaned between each boring to help prevent cross-contamination between the boreholes. Sampling tools will be cleaned between each sample collection event using a non-phosphate detergent wash and clean water rinse to help prevent cross-contamination between samples.

Soil cuttings and water will be placed into separate 55-gallon drums for temporary storage in a designated location. Upon completion of the waste profile requirements for disposal, the drums will be transported to a designated landfill or treatment facility.

Field Assumptions

- The proposed work will be conducted within the property limits based upon historical leases with the railroad. An access agreement with the Illinois Railway will be required.
- Field personnel and drilling subcontractors will be able to access all required portions of the site. All monitoring well locations will be accessible to a truck-mounted drill rig or suitable alternative.
- Field personnel will attempt to locate the proposed borings in readily accessible areas.
- Borings will be completed to refusal/bedrock (estimated to be approximately 23 to 25 ft bgs)
- Groundwater wells will be constructed such that the screened interval will intersect the water table (estimated to be approximately 23 to 25 feet bgs).
- Site access will be available at all times for field activities.
- EPA personnel will have access to groundwater wells installed as part of this FSP.

Schedule

Field activities will begin within 30 days of EPA approval of the FSP. Results of the soil sampling activities are expected approximately 15 days after completion. The results will be evaluated to assess if monitoring well installation and groundwater sampling are necessary as described in this FSP. If monitoring well installation and sampling are needed, BP will provide to EPA proposed monitoring well locations within 30 days after receipt of the results of the soil sampling activities. Monitoring well installation activities will begin with 30 days of EPA approval of the proposed monitoring well locations.

Mary Wojciechowski
Operations Project Manager

Attachments:
Figure 1 - Site Location Map
Figure 2 - Proposed Soil Boring Location Map
Attachment 1 – Soil Sampling SOP
Attachment 2 – Low Flow Groundwater Sampling SOP

Cc: Douglas Reinhart, BP Legal
Jacqueline Clark, EPA
Thomas Kenney, EPA
Stantec Consulting Services Inc.

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APPROXIMATE SCALE (FEET)

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FOR:
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SITE LOCATION MAP
BP SITE #5482
FORMER BULK PLANT
WEDRON, ILLINOIS

FIGURE: **1**

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182630000	KM	AG	LP	08/21/13

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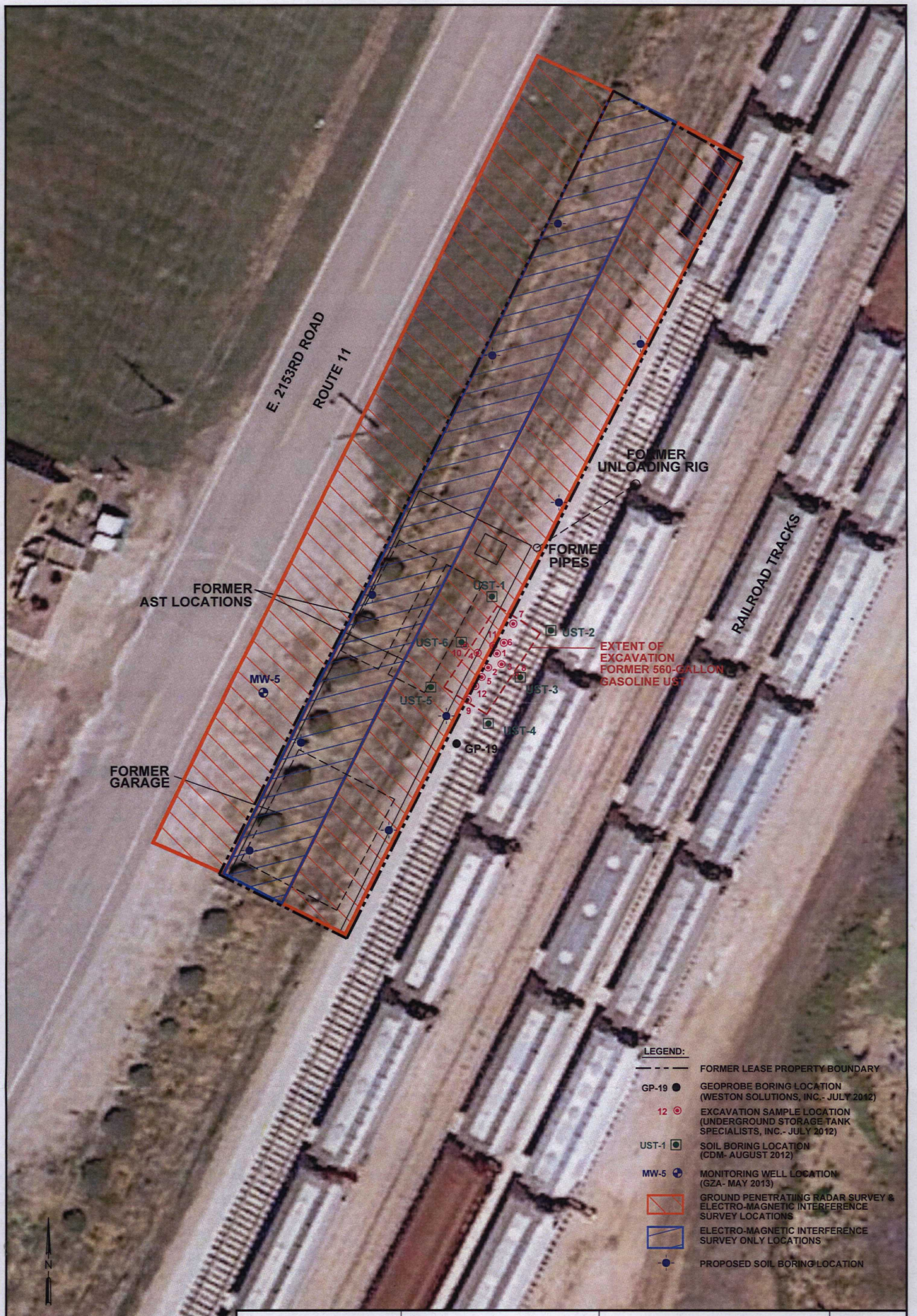

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PROPOSED SOIL BORING LOCATION MAP
BP SITE #5482 FORMER BULK PLANT
WEDRON, ILLINOIS

FIGURE: **2**

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1.0 PURPOSE & APPLICABILITY

The purpose of this document is to define the standard operating procedure (SOP) for collecting soil samples when drilling with hollow-stem augers, direct push, and hand auger methods. The ultimate goal of the sampling program is to obtain samples that meet acceptable standards of accuracy, precision, comparability, representativeness, and completeness. All steps that could affect tracking, documentation, or integrity of samples have been explained in sufficient detail to allow different sampling personnel to collect samples that are equally reliable and consistent.

This procedure provides descriptions of equipment, field procedures, sample containers, decontamination, documentation, decontamination, storage, holding times, and field quality assurance (QA) and quality control (QC) procedures necessary to collect soil samples.

While the Project Quality Assurance Project Plan (QAPP) is intended to be strictly followed, it must be recognized that field conditions may force some modifications to the SOP. Any modification to the procedure shall be approved by the Project Manager or Task Leader in advance. Where SOP modification is planned sufficiently in advance, regulatory agency concurrence will be sought prior to conducting the specific activity. When direct contact with regulatory agency staff is not possible, or unscheduled delays will result, such as during field activities, regulatory agency will be notified of deviations from the SOPs, in writing, as soon as possible after the occurrence.

2.0 DEFINITIONS

HASP	Health and Safety Plan
OSHA	Occupational Safety and Health Administration
PID	Photoionization Detector
PPE	Personal Protective Equipment
PVC	Polyvinyl Chloride
QA	Quality Assurance
QC	Quality Control
QAPP	Quality Assurance Project Plan
SAP	Sampling and Analysis Plan
SOP	Standard Operating Procedure
USCS	Unified Soil Classification System
VOA	Volatile Organic Analysis
VOCs	Volatile Organic Compounds

3.0 HEALTH AND SAFETY CONSIDERATIONS

Refer to the site-specific Health and Safety Plan (HASP) for health and safety considerations applicable to soil sampling.

Many hazards should be considered during the soil sampling activities, careful consideration of these hazards by the project team is essential. Some of the hazards include the following:

- Proper utility clearance must be performed in accordance with the Pre-Drilling/Excavation Checklist and Utility Clearance Log. There must be a minimum clearance of five (5) feet in addition to the diameter of the drilling augers. Client-specific requirements may be more restrictive.
- Traffic control may be required depending on the proximity of soil sampling activities to the roadway. Traffic control plans should be carefully evaluated to adequately delineate the work zone and provide the necessary safety factors.
- Personal protective equipment (PPE) including hard hats, high visibility traffic vest, gloves, hip boots or chest waders and other appropriate clothing;
- Heat and cold stress;
- Biological hazards such as insects and spiders. Appropriate clothing is required such as long-sleeved shirts and long pants.
- Bloodborne pathogens. Some of our sites may have syringes and other drug paraphernalia that must be carefully avoided.
- Chemical exposure on sites with open contamination. Respiratory protection may be necessary. Proper selection of respiratory protection is essential and an understanding of its limitation (i.e., negative pressure respiratory protection does not supply oxygen in an oxygen-deficient atmosphere). Staff should familiarize themselves with exposure limits for contaminants of concern.
- Use of air monitoring instrumentation will likely be necessary. We must be careful to make sure that our instrumentation is appropriate for the airborne contaminants of interest and that our staff understands the limitations of the instrumentation. Staff must also understand and perform calibration including zeroing with zero gas cylinders and appropriate other calibration gases.
- Decontamination of equipment and personnel must be properly designed and constructed to be sure that contamination is kept within the boundaries of the exclusion zone;
- Noise and proper use of hearing protection devices such as ear plugs and muffs.
- Emergency action plan must be carefully coordinated in advance between Stantec, our subcontractors, the client, and emergency responders.

All of these risks and others must be discussed with our subcontractors and clients to be sure they are properly addressed. Once the issues have been addressed at a project management level, they must be communicated to the staff that will actually perform the work. Details of procedures, instrument measurements and calibration, and other activities must be recorded in the field log and/or on data collection forms.

4.0 QUALITY ASSURANCE PLANNING CONSIDERATIONS

Soil sampling shall be done by personnel familiar with the common sources of random and systematic error so appropriate decisions can be made in the field. Some of the common phenomena which may degrade the sample quality collected from the well point are listed below.

- **Volatilization.** Volatilization occurs when the sample is in contact with air for an extended time. Typically volatilization occurs if the sample undergoes excessive disturbance during sampling or if air pockets exist at the top of the container. Limiting disturbance during sampling, filling sample containers in order of volatility, and tight capping of bottles immediately after filling will minimize these errors.

- **Adsorption/desorption.** This is the gain or loss of chemicals through exchange across surfaces. Adsorption may occur when the sample comes in contact with large surface areas such as the sampling container. Thorough decontamination of sample collection containers/monitoring equipment probes along with expedient transfer from the sample container to the labrotory container minimizes sorption effects.

- **Chemical reaction.** Dissolved chemical constituents may change due to reactions such as oxidation, hydrolysis, precipitation, etc. Proper preservation and adherence to holding times minimize these reactions.

- **Sample contamination.** Sample contamination is the most common source of errors and can result from several factors, including incomplete decontamination, contact with other samples, and contact with the atmosphere. Careful attention to decontamination, handling, and container sealing minimizes sample contamination.

5.0 RESPONSIBILITIES

The Project Manager or Task Leader will be responsible for assigning project staff to complete soil sampling activities. The Task Leader will also be responsible for assuring that this and any other appropriate procedures are followed by all project personnel.

The project staff assigned to the soil sampling will be responsible for completing their tasks according to this and other appropriate procedures. All staff will be responsible for reporting deviations from the procedure or nonconformance to the Task Leader, Project Manager or Project QA/QC Officer.

6.0 TRAINING AND QUALIFICATIONS

Only qualified personnel shall be allowed to perform this procedure. At a minimum, Stantec employees qualified to perform soil sampling will be required to have:

- Read this SOP.

- Read project-specific QAPP.
- Indicated to the Task Leader that all procedures contained in this SOP are understood.
- Completed the Occupational Safety and Health Administration (OSHA) 40-hour training course, and/or annual 8-hour refresher course, as appropriate.
- Coordinated any proposed sampling activites with the laboratory to ensure proper sampling procedures.
- Previously performed soil sampling activities generally consistent with those described in this SOP.

Stantec employees who do not have previous experience with soil sampling will be trained on site by a qualified Stantec employee, and will be supervised directly by that employee until they have demonstrated an ability to perform the procedures.

7.0 REQUIRED MATERIALS

The following is a typical list of equipment that may be needed to perform soil sampling:

- Auger rig or direct-push unit with appropriate equipment for sampling, or hand auger.
- Continuous soil sampler (2-½-inch x 18-inch or 2-foot split-spoon sample tube) or direct-push clear acetate or polyvinyl chloride PVC tube (typically 4-foot long).
- Photoionization detector (PID) or other air monitoring instrumentation as required by the HASP.
- 4-mil-thick plastic sheeting or aluminum foil.
- Tape measure.
- Unified Soil Classification System (USCS) based on the Visual-Manual Procedures in ASTM Standards D 2487-00 and D 2488-00.
- 5035 sample containers with lids.
- Terra-cores™ or similar coring sampling device, if required.
- Sample labels.
- Stainless steel trowels, putty knives or similar soil working tool.
- Penetrometer (if available).
- Waterproof marking pens, such as the Staedtler Lumocolor.
- Coolers (with ice) for sample storage and shipment.
- Sample data forms/clip board.

- Decontamination supplies (Alconox™ [or similar detergent], brush, bucket).
- Nitrile gloves, or other specified chemical resistant gloves.
- Work gloves.
- Camera and film or disks.
- Blank soil borehole logs or a field-logging PDA.
- Personal safety gear (hard hat, steel-toed boots, ear plugs, safety glasses, etc.).

8.0 METHODS

8.1 Hollow-Stem Auger/Direct Push Sampling

Make sure that all equipment and meters have been calibrated to the equipment specifications and the results have been recorded in the field log.

The top five (5) feet of the boreholes will be cleared via air knife, vacuum excavation, ground penetrating radar, hand auger, tile probe or some combination of these methods.

Shallow soil boreholes are typically drilled with hollow-stem augers or geoprobe and sampled at the intervals specified in the work plans. Sampling shall be done in advance of the lead auger to minimize cross-contamination. Samples for laboratory analysis shall be taken with a continuous soil sampler. Standard blow counts shall be recorded for driving the sampler 6 and 12 inches (ASTM Method D 1586-99) if sampler is hammer driven.

Upon retrieval of the sample, the sample will placed on a clean surface (or lined with disposable aluminum foil or plastic sheeting) and will be screened with a PID for locating potential elevated PID readings. If applicable, a representative grab sample will be collected along with a headspace sample and placed into the appropriately labeled sample container. The sample containers shall be placed in self-sealing plastic or bubble bags in a cooler with ice or frozen ice packs for storage until they are delivered to the analytical laboratory.

The following method is to be used for headspace screening:

- The portion (for headspace screening) should be placed into an appropriately sized re-sealable Ziploc® or equivalent bag;
- Seal and label the bag with the borehole identification and the depth of the sample;
- Allow the bag to equilibrate for approximately ten (10) minutes; and
- Insert the probe tip of the PID into the bag. Obtain a measurement using the PID.

The remainder of the sample shall be logged in accordance with the USCS and recorded on the boring logs according to the following procedure:

1. As much information as possible is to be shown in the heading of each log. This includes, but is not limited to:

   - Project name and project identification number;
   - Identification of borehole;
   - Name of drilling company;
   - Make, model, type, and size of drilling and sampling equipment used;
   - Date and time of start and end of drilling
   - Name of geologist(s) logging boring;
   - End of boring depth; and,
   - Depth to water (if encountered).

2. Each log is to begin with a description of the surface, (i.e., native, paved with asphalt, paved with concrete, and such). If any concrete is cut to open the hole, the thickness will be noted.

3. Every foot will be accounted for, with no gaps. If an interval is not sampled it will be noted. If an attempt is made to sample an interval, but there is no recovery, it will be noted.

4. Complete construction details are to be detailed for each well on a standard well construction form. Construction details should include:

   - A description of the type and length of casing i.e., 20' of 2" inner diameter (ID) Schedule 40 PVC casing;
   - Length and depths of the top and bottom of the screened interval;
   - Screen slot size;
   - Depths of the top and bottom of the filter pack;
   - Filter pack materials and sand size;
   - Depths and types of bentonite seals;
   - Detail of the use of grout; and,
   - Detail of the surface completion (i.e., stick up, flush-mounted).

5. The number of bags of sand, bentonite, and grout used will be counted. These numbers will be compared daily with the driller's daily report.

Soil cuttings will be stockpiled on 4-mil thick plastic sheeting or drummed. The cuttings and other investigation-derived waste will be managed in accordance with the work plan or client-specific directives.

When sampling for volatile organic compounds (VOCs), use USEPA Method 5035. Method 5035 requires ample preservation in the field at the point of collection. The preservative used for the low concentration soil method (0.5 to 200 µg/kg) is sodium bisulfate and the preservative used for the medium/high concentration soil method (>200 µg/kg) is methanol. This field collection and preservation procedure is intended to

prevent loss of VOCs during sample transport, handling, and analysis. The holding time for VOC analysis is 14 days.

1. Use the lab provided plunger style sampler (T-handle, syringe with tool, or terra-core™ sampler) to collect a 5g soil sample.
2. Unscrew the lid of the lab provided pre-preserved sodium bisulfate volatile organic analysis (VOA) vials and inject the 5g soil sample.
3. Tightly seal the VOA vial.
4. Repeat this step with the second sodium bisulfate VOA vial.
5. Then, repeat with the methanol preserved VOA vial.
6. Collect a soil sample in the 4-ounce wide mouth glass jar provided by the lab.
7. Make sure sample containers are labeled and bagged in plastic or bubble bags.
8. Ice the samples.

8.2 Hand Auger Sampling

Shallow soil boreholes less than five (5) feet in depth can be collected using a hand auger. The auger will be advanced until the desired sampling depth is reached. The auger will be removed from the boring, the sample will be extracted from the hand auger and field screened (as appropriate), and representative grab samples will be collected and placed into the appropriate labeled sample container. Decontamination of the auger and extensions will occur after each sample.

Boreholes will be abandoned by backfilling with bentonite chips and hydrating with potable water.

8.3 Excavation

Excavations and test pits will be excavated using a backhoe provided by the subcontractor. The dimensions of individual excavations will vary depending on the strength and stability of the trench walls and the specific purpose of the trench. Excavations greater than four (4) feet deep will not be entered by any personnel unless shoring is performed or the sides are stepped back to the proper angle per OSHA requirements.

When starting an excavation, the backhoe operator will first remove the topsoil or cover (if any) and place it in a discrete mound at least five (5) feet from the edge of the excavation. The excavation will be continued in approximately 6-inch cuts with the backhoe using a horizontal scraping motion rather than a vertical scooping motion. If a visibly-stained or otherwise chemically-affected soil interval is encountered, the affected excavated soils will be placed on 4-mil thick plastic sheeting.

8.3.1 Excavation Sampling

Samples will be collected from the backhoe bucket using a stainless steel trowel or similar. The top layer of soil will be removed prior to collecting the sample. The soil will then be placed in the appropriately labeled sample container and placed inside a chilled cooler.

8.3.2 Excavation Backfilling

The soils will be replaced in the excavation at their original depths to the extent practicable so that the soil from the bottom of the trench will be placed on the bottom, and the topsoil will be replaced on the top. The backhoe will be used to backfill and compact the excavation.

Upon completion and subsequent backfilling of each excavation, four corners will be marked with a wooden stake for surveying. If appropriate, a fifth stake will be placed above the location where a soil sample was collected. The points may be surveyed, as needed.

8.4 Decontamination Methods

8.4.1 Sampling Equipment Decontamination

The following steps will be used to decontaminate sampling equipment:

- Ensure that the decontamination process has been carefully designed to be sure that the solutions used are appropriate for the chemicals of interest.
- Ensure that the decontamination area is properly constructed to keep contamination within the contamination reduction and exclusion zones.
- Ensure that the decontamination area is properly constructed to contain the rinse solutions and solids.
- Personnel will dress in suitable safety equipment to reduce personal exposure.
- Smaller equipment that will not be damaged by water will be placed in a wash bucket containing an Alconox™ (or equivalent) solution and scrubbed with a brush or clean cloth. Smaller equipment will be rinsed in water. Change rinse and detergent waters between boreholes, as needed.
- For larger drilling equipment the soil and/or other material will be scraped off with a flat-bladed scraper, and placed within a deconcontamination (decon) pad. The decon pad will be constructed in a predetermined location, and equipment shall be cleaned with a pressure washer using potable water. Care will be taken to adequately clean the insides of the hollow-stem augers, and cutter heads.
- Equipment that may be damaged by water will be carefully wiped clean using a

sponge and detergent water and rinsed in or wiped down with distilled water. Care will be taken to prevent any equipment damage.

Following decontamination, equipment will be placed in a clean area or on clean plastic sheeting to prevent contact with potentially contaminated soil.

Following decontamination, drilling equipment will be placed on the clean drill rig and moved to a clean area. If the equipment is not used immediately, it will be stored in the designated secure, clean area.

8.4.2 Excavation Decontamination

Decontamination protocols must be carefully designed and constructed to deal with the chemicals of interest and ensure that the rinse solutions and solids are contained within the contamination reduction zone.

The backhoe bucket will be decontaminated prior to excavating each excavation. The entire backhoe, bucket, and tires will be decontaminated at the conclusion of the trenching operation. Decontamination will involve using a steam cleaner with an Alconox™ solution or pressure washer and rinsing using a steam cleaner or pressure washer with potable water. Backhoe decontamination will take place at the decontamination area located adjacent to the maintenance building or at another appropriate location.

The sampling equipment will be decontaminated prior to collecting each sample. Decontamination will consist of washing the equipment with a scrub brush in a bucket with an Alconox™ solution (or equivalent) and rinsing the equipment in a bucket filled with tap water. The date and time of decontamination of the backhoe and sampling equipment will be recorded in the field book and/or data collection forms.

8.5 Sample Containers, Storage, and Holding Times

Refer to the Project Sampling and Analysis Plan (SAP) for project specific instructions on proper containers, storage of samples and allowable holding times.

9.0 QUALITY CONTROL CHECKS AND ACCEPTANCE CRITERIA

Refer to the QAPP and SAP for specific quality control checks and acceptance criteria.

10.0 DOCUMENTATION

A borehole log will be completed for each hollow-stem auger or direct-push borehole. The field notebook and/or data collection forms will contain the following information:

- Project name and number.
- Drilling company's name.
- Date drilling started and finished.
- Type of auger and size (ID & OD).

- Type of equipment for air monitoring (PID or FID).
- Air monitoring calibration and measurements.
- Well completion and graphic log.
- Driller's name.
- Geologist's or engineer's name.
- Type of drill rig.
- Borehole number.
- Surface elevation (if available).
- Stratigraphic description with depth.
- Classification of the soils according to the USCS.
- Water levels and light non-aqueous phase liquid levels, if applicable.
- Drilling observations.
- Map of borehole or monitoring well location.

In addition, proper documentation will include observance of the chain of custody procedures as described in the Project QAPP and SAP.

Additional information regarding field documentation for borehole logging for fine- and coarse-grained soils and rocks is provided in Stantec checklists ERPA-603 through ERPA-605.

ACCEPTANCE

Author/Originator

Peer Reviewer

Senior Reviewer

Environment Practice QA/QC Manager

1.0 PURPOSE & APPLICABILITY

The purpose of this document is to define the standard operating procedure (SOP) for collecting low flow groundwater samples. The ultimate goal of the sampling program is to obtain samples that meet acceptable standards of accuracy, precision, comparability, representativeness, and completeness. All steps that could affect tracking, documentation, or integrity of samples have been explained in sufficient detail to allow different sampling personnel to collect samples that are equally reliable and consistent.

This procedure gives descriptions of equipment, field procedures, sample containers, decontamination, documentation, storage and holding times, and field QA/QC procedures necessary to collect soil samples.

This procedure may apply to all sampling by Stantec personnel or their subcontractors by the aforementioned sampling methods.

It must be recognized that field conditions may force some modifications to the SOP. Any modification to the procedure shall be approved by the Project Manager or Task Leader in advance and sufficiently documented so that the reason for the deviation can be clearly articulated to our clients and regulators, as necessary. Where SOP modification is planned sufficiently in advance, regulatory agency concurrence will be sought prior to conducting the specific activity.

2.0 DEFINITIONS

FSP	Field Sampling Plan
HASP	Health and Safety Plan
OSHA	Occupational Safety and Health Administration
QA/QC	Quality Assurance/Quality Control
QAPP	Quality Assurance Project Plan
SOP	Standard Operating Procedure
WP	(Project) Work Plan

3.0 HEALTH AND SAFETY CONSIDERATIONS

Consideration of Health and Safety risks prior to performing this work is paramount. This risk review may be performed by modifying a generic or existing Job Safety Analysis in the HASP. There are many items to be considered. Following is a short list of the items for consideration. Careful review of these items and other site-specific conditions by the project team is essential.

- Traffic guidance and control. Even plans developed by outside traffic control contractors need to be carefully evaluated to make sure they are protective of our staff and contractors.
- Personal protective equipment, including hard hats, high-visibility traffic vest, gloves, appropriate clothing.
- Heat and cold stress.

- Biological hazards such as insects and spiders. Appropriate clothing is required such as long-sleeved shirts and long pants.
- Bloodborne pathogens. Some of our sites may have syringes and other drug paraphernalia that must be carefully avoided.
- Chemical exposure on sites with open contamination. Respiratory protection may be necessary. Proper selection of respiratory protection is essential and an understanding of its limitation (i.e., negative pressure respiratory protection does not supply oxygen in an oxygen-deficient atmosphere). Staff should familiarize themselves with exposure limits for contaminants of concern.
- Emergency action plan must be carefully coordinated in advance between Stantec, our subcontractors, the client, and emergency responders.

All of these risks and others must be discussed with our subcontractors and clients to be sure they are properly addressed. Once the issues have been addressed at a project management level, they must be communicated to the staff that will actually perform the work. Details of procedures, instrument measurements and calibration, and other activities must be recorded in the field log and/or on data collection forms.

4.0 RESPONSIBILITIES

The Project Manager or Task Leader will be responsible for assigning project staff to complete low flow groundwater sampling activities. The Task Leader will also be responsible for assuring that this and any other appropriate procedures are followed by all project personnel.

The project staff assigned to the low flow sampling tasks will be responsible for completing their tasks according to this and other appropriate procedures. All staff will be responsible for reporting deviations from the procedure or nonconformance to the Task Leader, Project Manager, or Project QA/QC Officer.

Only qualified personnel shall be allowed to perform this procedure. At a minimum, Stantec employees qualified to perform groundwater sampling will be required to have:

- Read this SOP.
- Read project-specific QAPP.
- Indicated to the Task Leader that all procedures contained in this SOP are understood.
- Completed the OSHA 40-hour training course and 8-hour refresher course, as appropriate.
- Previously performed low flow groundwater sampling activities generally consistent

with those described in this SOP.

5.0 TRAINING/QUALIFICATIONS

Stantec employees who do not have previous experience with low flow groundwater sampling will be trained on site by a qualified Stantec employee and supervised directly by that employee until they have demonstrated an ability to perform the procedures.

6.0 REQUIRED MATERIALS

The following is a typical list of equipment that may be needed to perform low flow groundwater sampling:

- Photoionization detector (PID) or other air monitoring instrumentation as needed.
- Sample containers with lids.
- Sample labels.
- Waterproof marking pens, such as the Staedtler Lumocolor.
- Coolers (with ice) for sample storage and shipment.
- Sample data forms/clip board.
- Decontamination supplies.
- Nitrile gloves, or other specified chemical-resistant gloves.
- Work gloves.
- Camera and film or disks.
- Blank groundwater parameter forms or a field-logging PDA.
- Personal safety gear (hard hat, steel-toed boots, etc.).
- Water level indicator or product-water interface probe.
- Centrifugal pump, bladder pump, Grundfos pump (or equivalent).
- Appropriately sized tubing (Teflon or equivalent).
- YSI 556 meter with flow-through cell (or equivalent).
- Turbidity meter, Hatch ferrous iron test kit (or equivalent) as needed.
- Buckets, drums or other containers for purge water.

7.0 METHODS

7.1 Purging Methods

Wells will be purged and sampled according to the following procedures:

- After the water levels and the depth of the wells have been measured, the monitoring wells will be purged at a low-flow rate using a centrifugal pump, bladder pump, Grundfos pump (or equivalent) and dedicated down-hole tubing while measurements of oxygen reduction potential (ORP), dissolved oxygen (DO), standard conductivity (SC), pH, temperature, ferrous iron and/or turbidity (as needed) are monitored using a YSI 556 meter with flow-through cell, appropriate meters and test kits. (The meters will be checked and calibrated prior to use as specified in the operations manuals.) After purging is initiated, the flow will be adjusted to a rate that results in minimal well draw down.

- The pump intake will be located near the middle of the screened interval of each well. Non-dedicated equipment will be decontaminated appropriately before use at each monitoring well.

- Purge rates for low-flow sampling are typically 0.1 - 0.5 liters per minute (L/min). A higher purge rate may be acceptable but this is based on the site hydrology and must be determined at each well location. At no point should the purge rate cause a change in water level of greater than 0.3 feet.

- When using a bladder pump, the pump should be set so that one pulse delivers the entire 40ml vial amount (not mandatory but "best practice").

- Peristaltic pumps should be used with caution. Usage should be based on the intent of the data. If the data is to be used for comparison to clean up goals or groundwater monitoring termination, then peristaltic pump should not be used.

- The well will be purged until water quality parameters (ORP, DO, SC, pH, temperature, and/or turbidity) have stabilized (generally within 10 percent) for three consecutive measurements taken at 3 to 5 minutes intervals or three (3) complete well volumes have been removed. USEPA recommendations for stability parameters are:

  - Turbidity - 10 percent
  - DO - 0.3 mg per Liter
  - Specific Conductance - 3 percent
  - Temperature - 3 percent
  - pH - ±0.1
  - ORP - ± 10mV

  This information will be recorded in a sampling form or on a field-logging PDA.

- Once the water quality parameters have stabilized, a groundwater sample will be collected in appropriate sample containers, or sampled with the appropriate test kit.
- Documentation of all purge data, including volumes (both of water purged and water sampled), elapsed times, pump-flow rates, water level and geochemical parameter measurements will be recorded on the sampling form.

7.2 Decontamination Methods

The following steps will be used to decontaminate sampling equipment:

- Ensure that the decontamination process has been carefully designed so that the solutions used are appropriate for the chemicals of concern.
- Personnel will don appropriate safety equipment to reduce personal exposure.
- Equipment that will not be damaged by water will be placed in a wash tub containing an Alconox™ (or equivalent) solution and scrubbed with a brush or clean cloth. Equipment will be rinsed in a second wash tub.
- Equipment that may be damaged by water will be carefully wiped clean using a sponge and detergent water, and wiped with organic-free deionized water. Care will be taken to prevent any equipment damage.

Following decontamination, equipment will be placed in a clean area or on clean plastic sheeting to prevent possible contamination. Single use equipment and consumables will be discarded in an appropriate manner.

8.0 QUALITY CONTROL CHECKS AND ACCEPTANCE CRITERIA

Refer to the Quality Assurance Project Plan for specific quality control checks and acceptance criteria.

9.0 DOCUMENTATION

A monitoring well low-flow groundwater sampling log will be completed for each monitoring well. The field notebook and/or data collection forms will contain the following information:

- Project name and number.
- Field staff/sampler's name.
- Date and time sampling started and finished.
- Type of equipment for air monitoring and air monitoring data (if applicable).
- Type, make and model number of low flow and sampling equipment used.
- YSI meter (or equivalent), calibration and measurements.

- Depth to groundwater, well bottom and dense non-aqueous phase liquid levels, if applicable.
- Monitoring well purge volume.
- Surface elevation (if available).
- Flow rates.
- ORP, DO, SC, pH, temperature, ferrous Iron and/or turbidity measurements or results and time.
- Additional sample analytical method or analytes and sample identification.
- Sample collection time.
- Sampler's observations.
- Description of monitoring well condition.

ACCEPTANCE

Author/Originator

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